Towards Robot Fall Detection and Management for Russian Humanoid AR-601

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Abstract. While interacting in a human environment, a fall is the main threat to safety and successful operation of humanoid robots, and thus it is critical to explore ways to detect and manage an unavoidable fall of humanoid robots. Even assuming perfect bipedal walking strategies and algorithms, there exist several unexpected factors, which can threaten existing balance of a humanoid robot. These include such issues as power failure, robot component failures, communication disruptions and failures, sudden forces applied to the robot externally as well as internally generated exceed torques etc. As progress in a humanoid robotics continues, robots attain more autonomy and enter realistic human environments, they will inevitably encounter such factors more frequently. Undesirable fall might cause serious physical damage to a human user, to a robot and to surrounding environment. In this paper, we present a brief review of strategies that include algorithms for fall prediction, avoidance, and damage control of small-size and human-size humanoids, which will be further implemented for Russian humanoid robot AR-601.

Keywords: Robot control · Humanoid robots · Safety · Humanoid robot fall · Safe fall · Fall prediction · AR-601

1 Introduction

Humanoid robotics is still considered a rather a young research field with many research challenges. While industrial robots are being widely used in manufacturing and their technology have reached high level of maturity with a variety of robots available from different manufacturers, only a few humanoid robots are currently commercially available. Most of full-size humanoids are built on customer request and come with a high price tag. Even though these humanoids share majority of their components (e.g. harmonic drive gears, controllers, sensors etc.), the systems differ significantly.

Humanoid robot locomotion is an extremely challenging research field as keeping stability during standing straight and locomotion is a necessary requirement for all applications of such robots. To address this issue problem of dynamically stable biped locomotion received significant attention over the last decades with some promising results [26–29].

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